

Protecting Wild Rice From Excess Sulfate: Proposed Approach

April 23, 2015



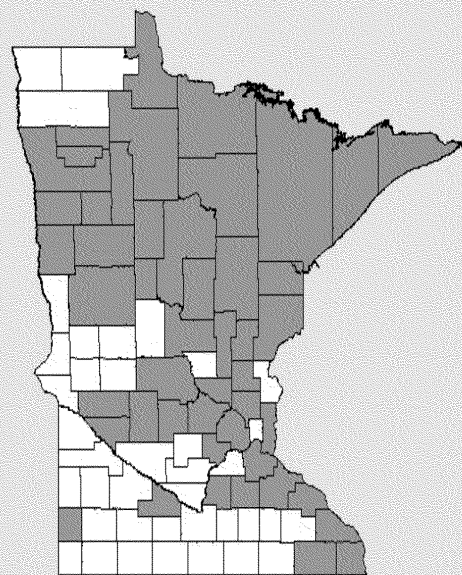
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Minnesota Pollution Control Agency



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Wild Rice in Minnesota

- Cultural/spiritual, ecological, economic resource
- Minnesota's state grain



PLANTS
Database

ZIZAN

Zizania L.

USDA-NRCS PLANTS Database



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Sulfate Sources to Surface Water

- ❑ Natural sources: driven by geology
- ❑ Can be found at elevated levels in discharges due to factors such as:
 - ❑ Source water high in sulfate
 - ❑ Runoff that contacts sulfur-containing minerals
 - ❑ Sulfate in some industrial processes and in municipal wastewater
 - ❑ Concentration by water treatment



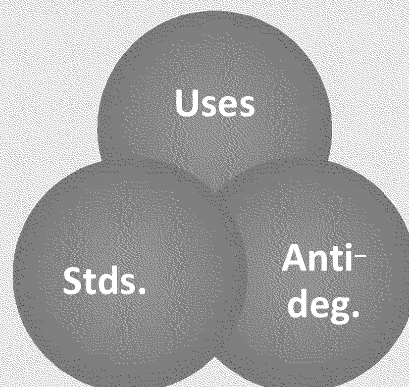
Credit: U.S. Fish and Wildlife Service



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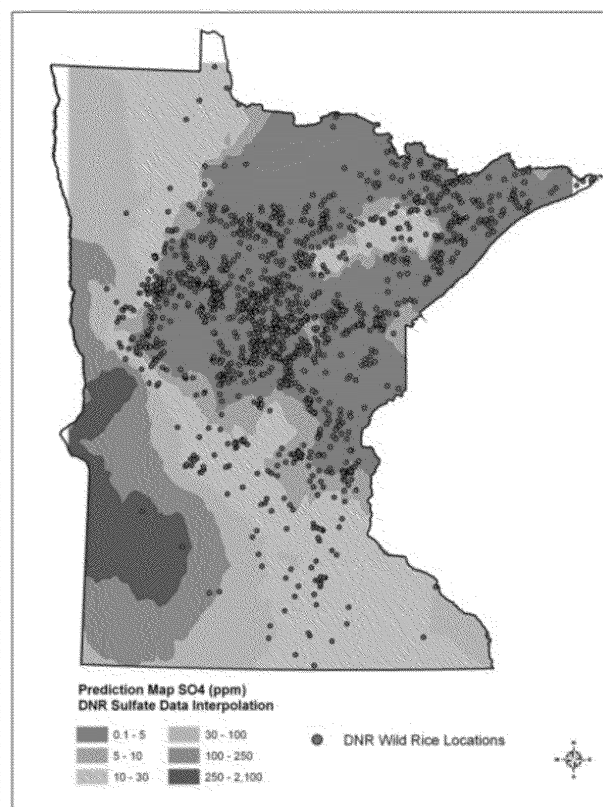
What Are WQ Standards?

- ❑ Fundamental tool of the Clean Water Act
- ❑ Address three key questions:
 1. What and who are we protecting?
 2. What conditions are protective?
 3. How do we maintain high water quality?



Wild Rice Sulfate Standard

- Studies found correlation between lower sulfate and wild rice
- Sulfate standard adopted in 1973 to protect wild rice production
 - “10 mg/L, applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels”



Implementing the Sulfate Standard

- ❑ Additional information needed
- ❑ 2011 Legislation:
 - ❑ \$1.5 million for wild rice standards study from the Clean Water, Land and Legacy Amendment
 - ❑ Advisory committee to provide input on study protocol, research results and rulemaking
 - ❑ MPCA to initiate rulemaking upon completing the study



Wild Rice Standard Study

- Goal: Enhance understanding of the effects of sulfate on wild rice; inform standard evaluation
- Key avenues of investigation:
 - Laboratory experiments
 - Mesocosm experiments
 - Field survey
 - Sediment experiments
- Any standard modification will be based on multiple information sources



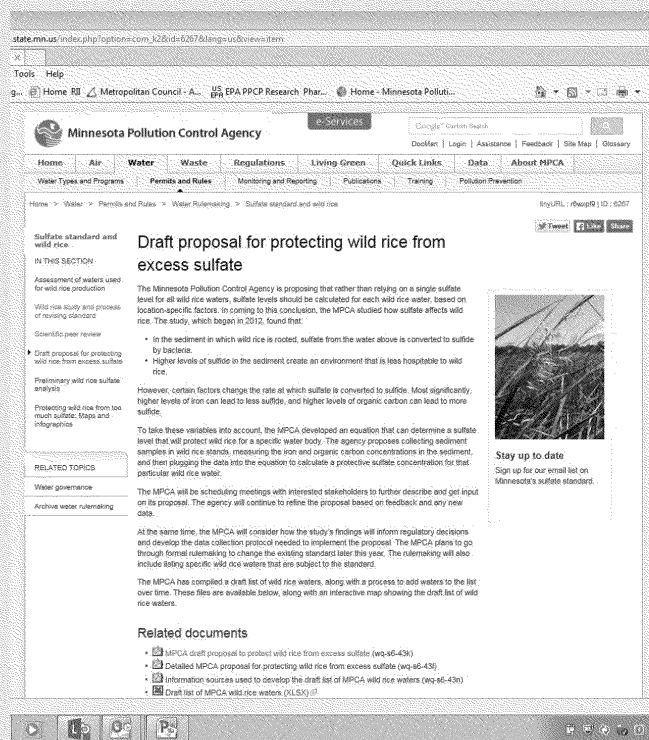
Study Results and MPCA Analysis

- ☐ Data collection completed in December 2013
- ☐ Preliminary Analysis March 2014
- ☐ Feedback from Advisory Committee, others
- ☐ Continued data analysis ☐ Draft Analysis for Peer Review (June 2014)
- ☐ Scientific peer review August-Sept. 2014
- ☐ Refined and expanded the analysis based on peer review, other scientific feedback
- ☐ <http://www.pca.state.mn.us/ktqh1083>



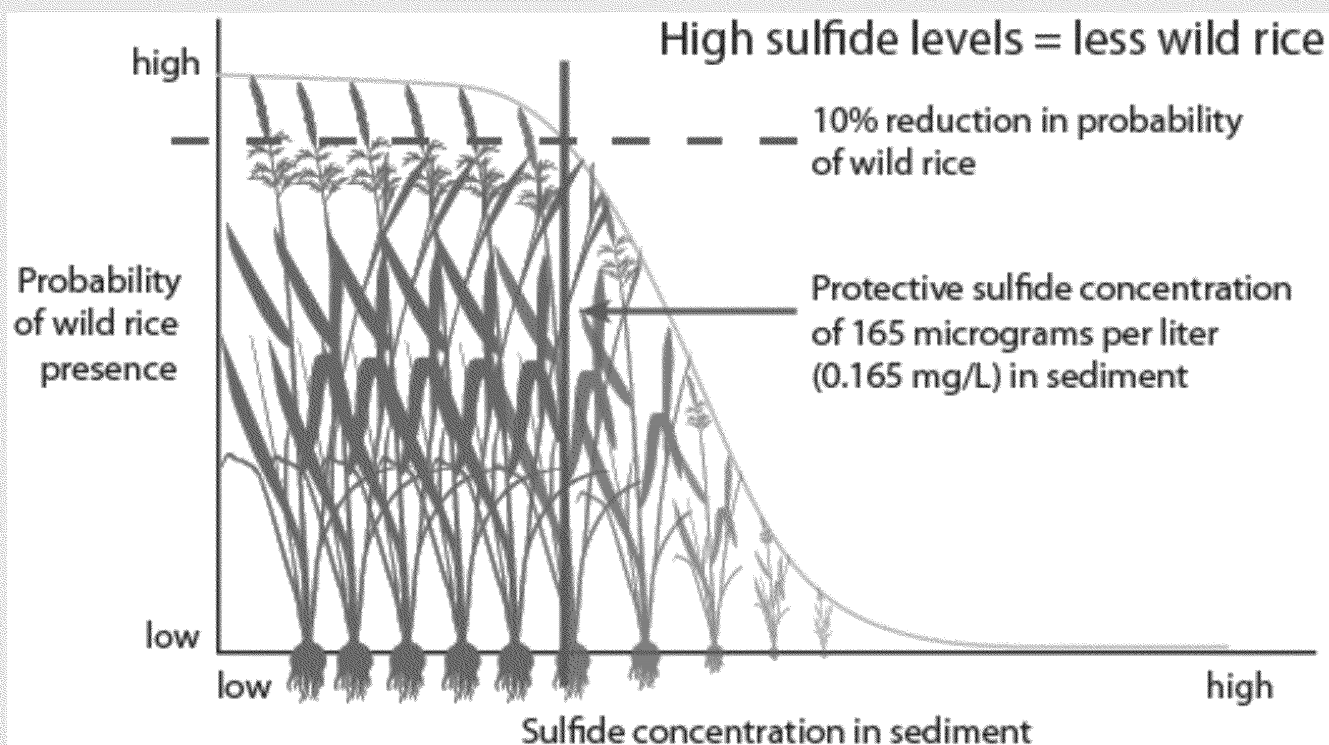
Draft Proposal for Protecting Wild Rice from Excess Sulfate: March 2015

- ❑ Proposed approach to “the standard”
- ❑ Draft list and definition of “wild rice waters”
- ❑ Identified implementation questions

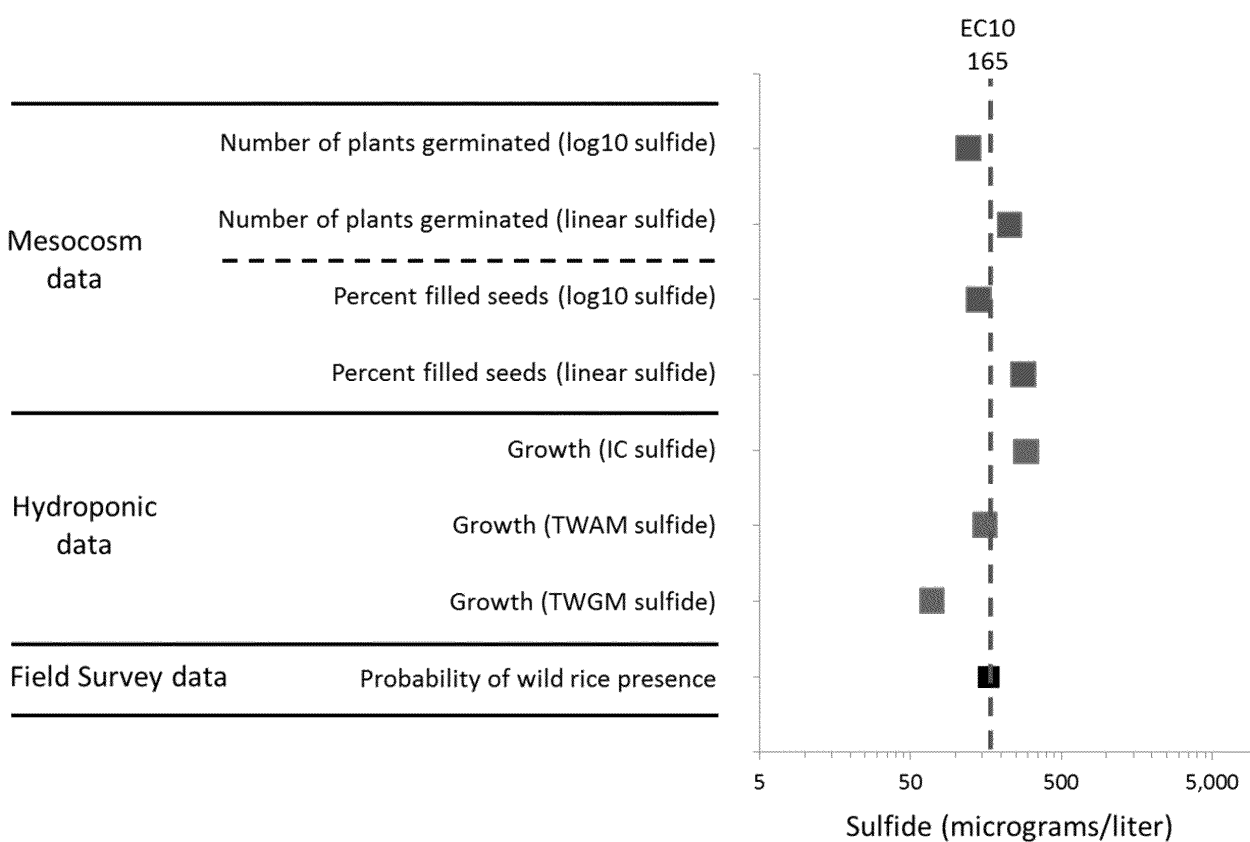


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Highlights of Draft Proposal

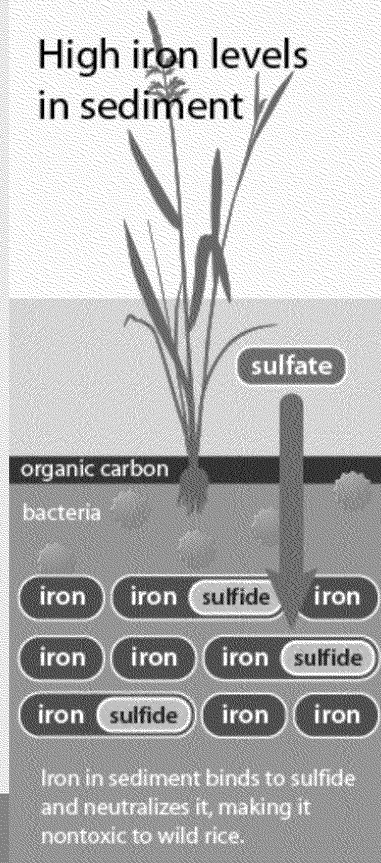


Multiple Lines of Evidence



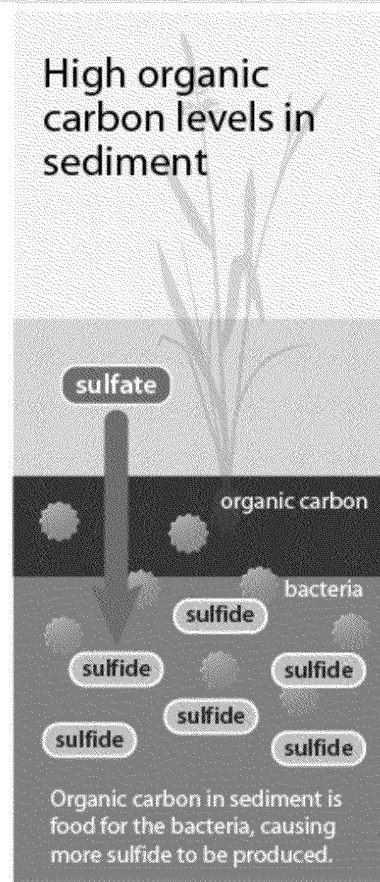
Sulfide – Sulfate Relationship

High iron levels
in sediment



–vs–

High organic
carbon levels in
sediment



Bacteria
in the
sediment
convert
sulfate to
sulfide.

Sulfide is
toxic to
wild rice.

Proposed Equation to Protect Wild Rice: DRAFT

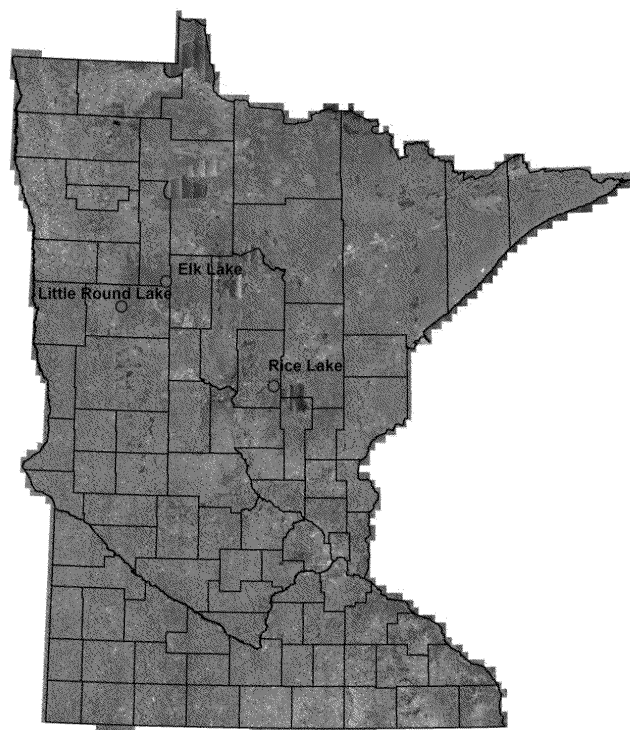
- ❑ Developed SEM relating sulfate, sulfide, iron and organic carbon
 - ❑ Multiple variables reviewed
 - ❑ Multiple regression also evaluated
 - ❑ SEM approach was more precise
- ❑ Integrated protective sulfide concentration (165 µg/L) into the modeled equation
- ❑ Evaluated strength of equation using bootstrapping and jack-knifing techniques

$$\text{Sulfate} = 0.0000136 \times \text{Organic Carbon}^{-1.410} \times \text{Iron}^{1.956}$$

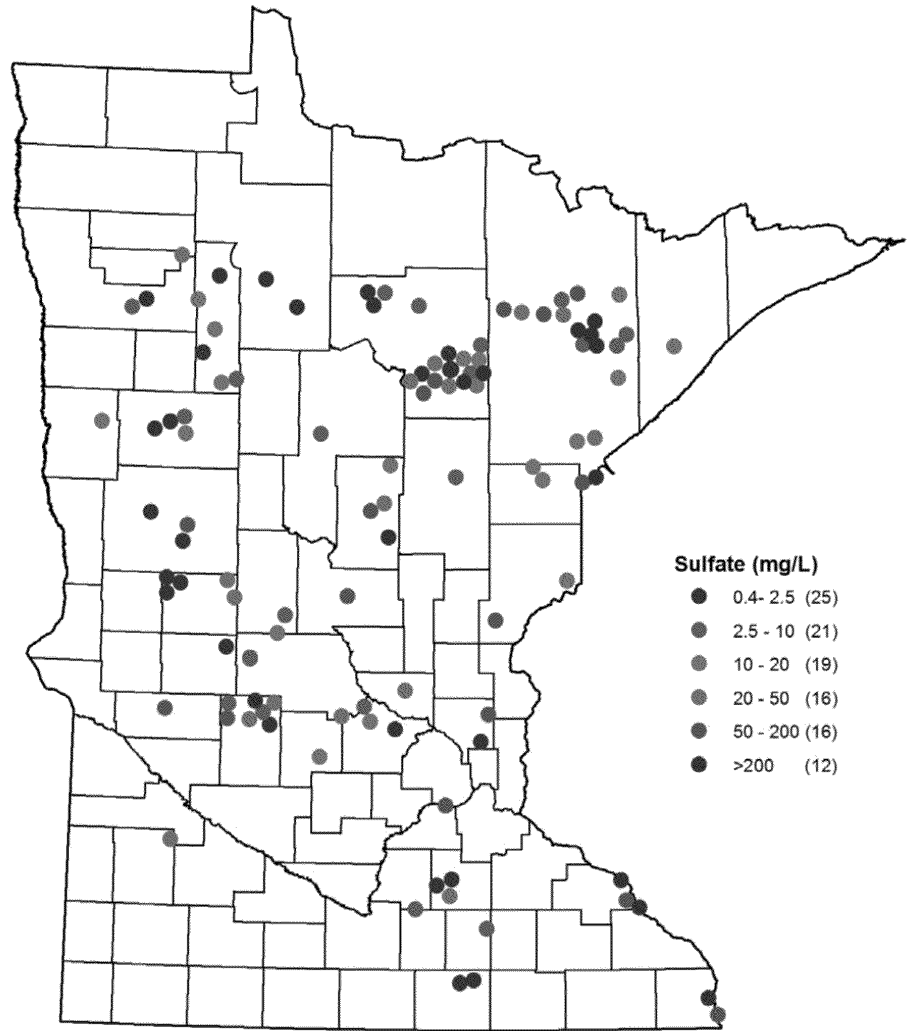


Sample Calculations

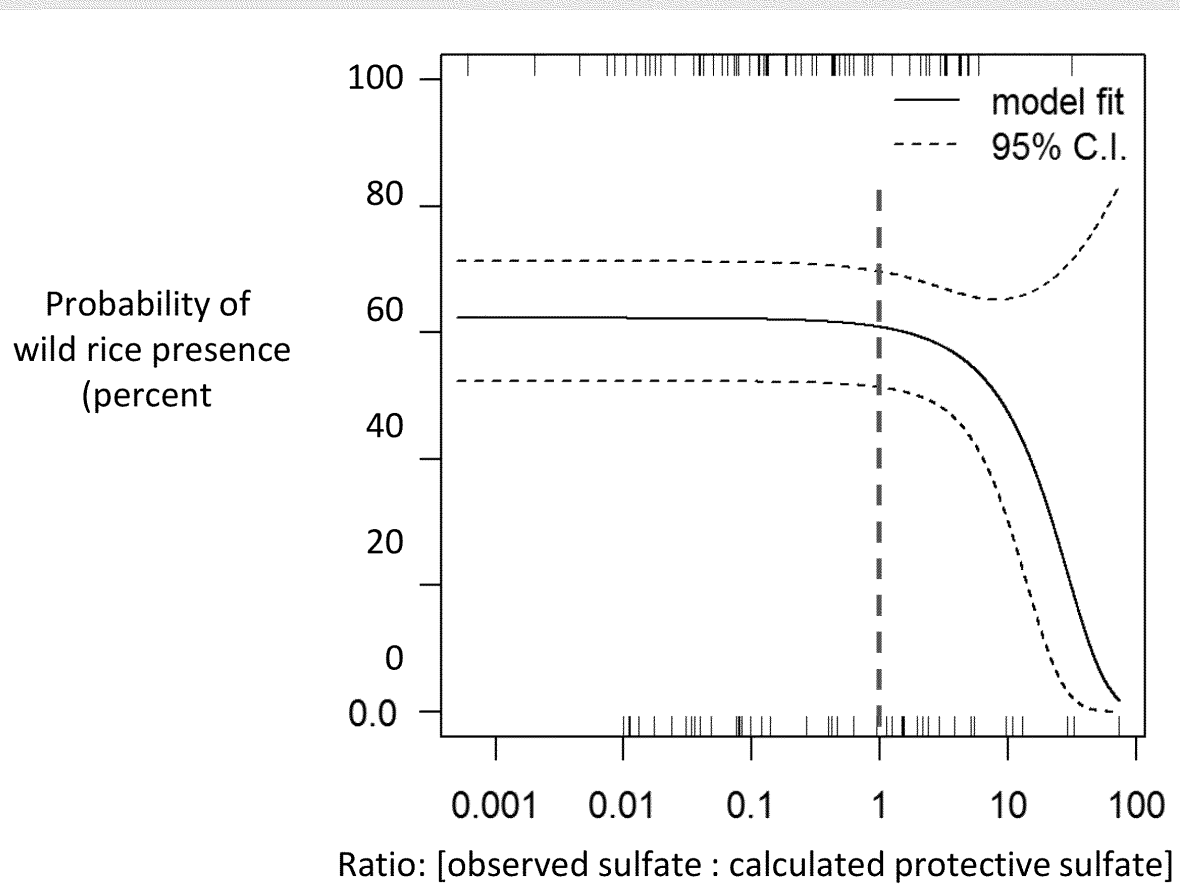
Study site	Sediment total organic carbon (%)	Sediment extractable iron ($\mu\text{g/g}$)	Calculated protective sulfate (mg/)
Little Round Lake	27.5	3,069	0.8
Elk Lake	10.2	8,480	25
Rice Lake	35.6	50,389	140



Calculated protective sulfate ranges at MPCA study sites

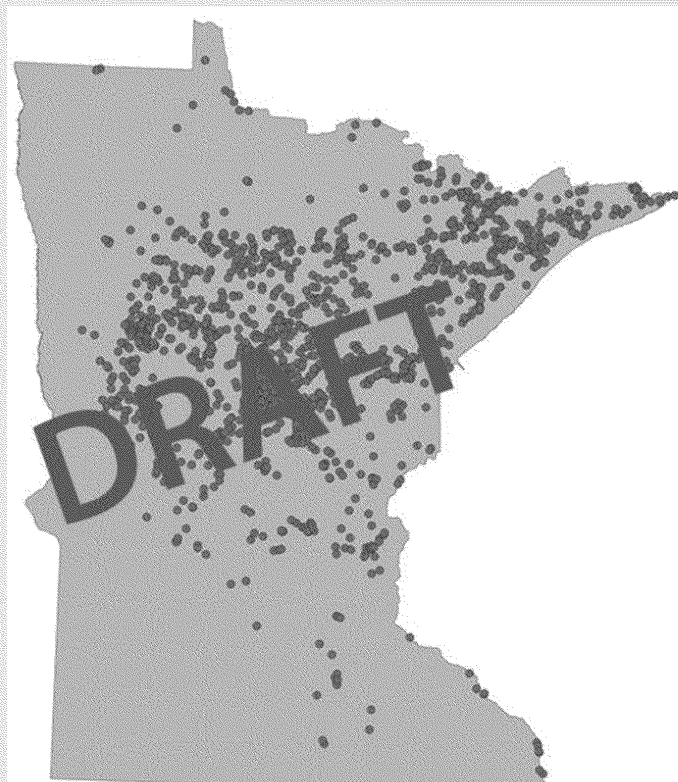


Probability of Wild Rice Presence as a function of the ratio [observed sulfate]:[calculated protective sulfate]

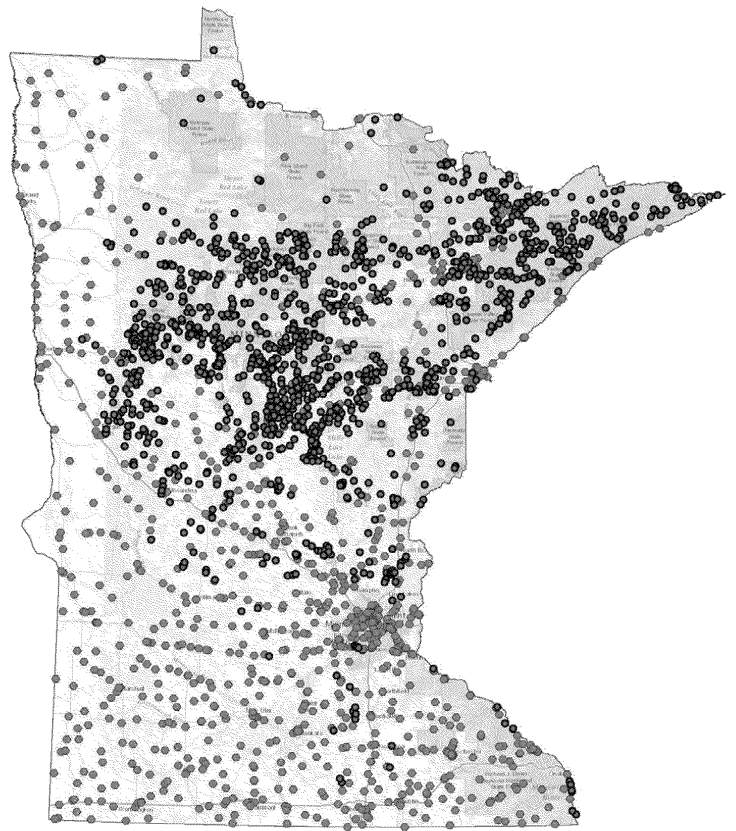


Draft List and Definition of Wild Rice Waters

- Considered acreage, density, human and wildlife use
- Draft proposed definition:
 - A surface water with a self-perpetuating population of wild rice plants, either currently present or that have been present since 11/28/1975.
 - A minimum of 8,000 wild rice stems over the surface of a lake, wetland, or reservoir; or a minimum of 800 wild rice stems over a river-mile reach.
- Reviewed multiple data sources to develop draft list



NPDES wastewater facilities and draft wild rice waters



Implementation Questions

- ☐ Sediment sampling protocol
- ☐ How to address variability in sampling results
- ☐ Monitoring priorities
- ☐ Translating results to permit limits – d i s t a n c e , duration...
- ☐ Data requirements for identification of additional wild rice waters
- ☐ Other?



Next Steps

- ☐ Receive feedback on draft proposal
- ☐ Evaluate additional research
- ☐ Additional sampling to inform implementation questions
- ☐ Refine proposal as needed; develop technical support document
- ☐ Begin rulemaking process
 - ☐ Request for comments
 - ☐ Public meetings
 - ☐ Administration law judge hearing
 - ☐ Adopted in State Register
 - ☐ EPA review and approval





Thank You!

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<http://www.pca.state.mn.us/ktqh1083>



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